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UTAH, THE OASIS AT THE FOOT OF THE WASATCH

By MARK JEFFERSON

In the heart of the basin country of the western United States, between the Rockies and the Sierra Nevada, lies an elongated belt of forty-six cities and towns, the least of which has a thousand indwellers and the greatest, Salt Lake City, a hundred thousand. Between these cities the valleys are covered with green wheat fields, squares of alfalfa and plowed land, and clouds of pink every spring when the fruit trees bloom, with the ranches of the owners dotted between. This strip of human occupation in the midst of the wilderness is Utah, the best-defined geographic unit of American states. East of it is the empty wilderness of the Green River canyon country, bristling with crags and cliffs, high plateau remnants isolated by gloomy defiles, with no town of a thousand people till one comes to Grand Junction, Colorado, 140 miles away. West of it for 400 miles stretch the deserts of Utah and Nevada without settlement save for the one little town of Ely, at a distance of 150 miles. At the southern boundary of the state is a gap of fifty miles between the southernmost town of Utah and the northernmost town of Arizona, and there is a similar gap on the north between the towns of Utah and Idaho.

For the most part, the states of the Union are not geographic but purely political or politico-social units. There is no geographic break between Ohio and Indiana or betweeen Indiana and Illinois. The farms and fields are continuous across the boundary, the wood-lots cross it. If a river makes a part of the boundary it is for convenience, or was for the convenience of early administrators when the marking of boundaries cost more than most of the land was worth and the ready-made line of a river-bed was a gift of nature.

As a matter of fact a river, especially if it be of navigable size, does not at all separate the activities of men. A large city on a state boundary inevitably pushes its suburbs across such a river into another state or even into a foreign country. The real city of New York long ago expanded across the Hudson into Jersey City and Hoboken in New Jersey, simply because the river is vital to the life of the city as our great seaport and that vital organ nourishes one shore as well as another. So Philadelphia has expanded across the Delaware and the state boundary into Camden, St. Louis across the Mississippi into Illinois at East St. Louis, and Detroit across its river into Canada at Windsor. In the Old World, where states have acquired their boundaries by a long, slow growth, an important river is rarely part of a boundary, and the great cities stand astride their rivers within a single administrative unit. In the eastern United States, if anything tells the traveler that he has passed from one jurisdiction to another, it is usually some product of legislation that has produced visible human works which extend only as far as the visible boundary. Generally human occupation flows uninterruptedly across the line. For the most part state boundaries are meridians and parallels, lines capable of being marked on the map even before a new country has been explored and readily established on the ground as soon as the cost can be covered. They are naturally in great vogue in all new lands, like Australia or inner Africa as well as America, which are subdivided on paper ahead of their actual occupation. As these lines have no inherent geographic character, but rather an astronomic one, the actual settlements, when they come, spread with the least possible heed to them.

But Utah is a group of homes without near neighbors. For hundreds of miles in every direction from Salt Lake City there are no other large towns. The Utah communities lie in a strip along the western base of the Wasatch, 350 miles long and only 50 wide. The irrigated lands of the state (Fig. 7) lie mainly in the same belt. They occupy 1,560 square miles, or about the same area as the town belt, which, according to the rough dimensions just given, would cover an area of 1,750 square miles. The political state is four or five times as wide. The traveler who crosses it by train has a long journey across empty spaces on either hand. Furthermore this compact isolated strip of settlements lies under the eastern bounding wall of a great depression in the western plateau country. The relief map (Fig. 1) shows this hollow in the plateau at the northwestern corner of the state of Utah. Its area is about 20,000 square miles. Its surface is everywhere less than 5,000 feet above the sea. Great Salt Lake lies at the lowest point of the basin, which was in ancient times filled by the fresher waters of Lake Bonneville, which overflowed to the Snake River valley to the northwest. It is observed that the northern towns of Utah all lie along the eastern border of this basin,—the southern ones at a slightly higher level, but, like the others, along the western foot of the Wasatch, which bounds the depression on the east. The map shows all the towns of the state that have more than 1,000 people, with the size in 1910 indicated by the symbols used.

On account of this situation at the border of a great depression in a dry country the name *oasis* is here applied to the state. For oases are essentially hollows in the desert where ground-water becomes available. Probably most minds react to the word ''oasis'' with a picture of a tuft of palms waving over a pool in the midst of desert sand. It is quite possible that no such pool exists in reality. It is probable that it would be difficult to maintain a pool in such a situation artificially. Oases occur in hollows for the same reason that water appears, in humid regions, when digging a well. The ground-water comes to the surface at the lowest point in its neighborhood.[1]

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[1] Readers will find instructive descriptions in E. Desor's " La forêt vierge et le Sahara," Paris, 1879.

The word "oasis" is Greek and was applied originally to the hollows in the Libyan Desert of Egypt. Five of these were famous: Siwa, Bakharieh, Farafra, Dakhel, and Khargeh, from 100 to 300 miles west of the Nile (Fig. 2). All of them, like the Nile flood-plain, are depressions far below the

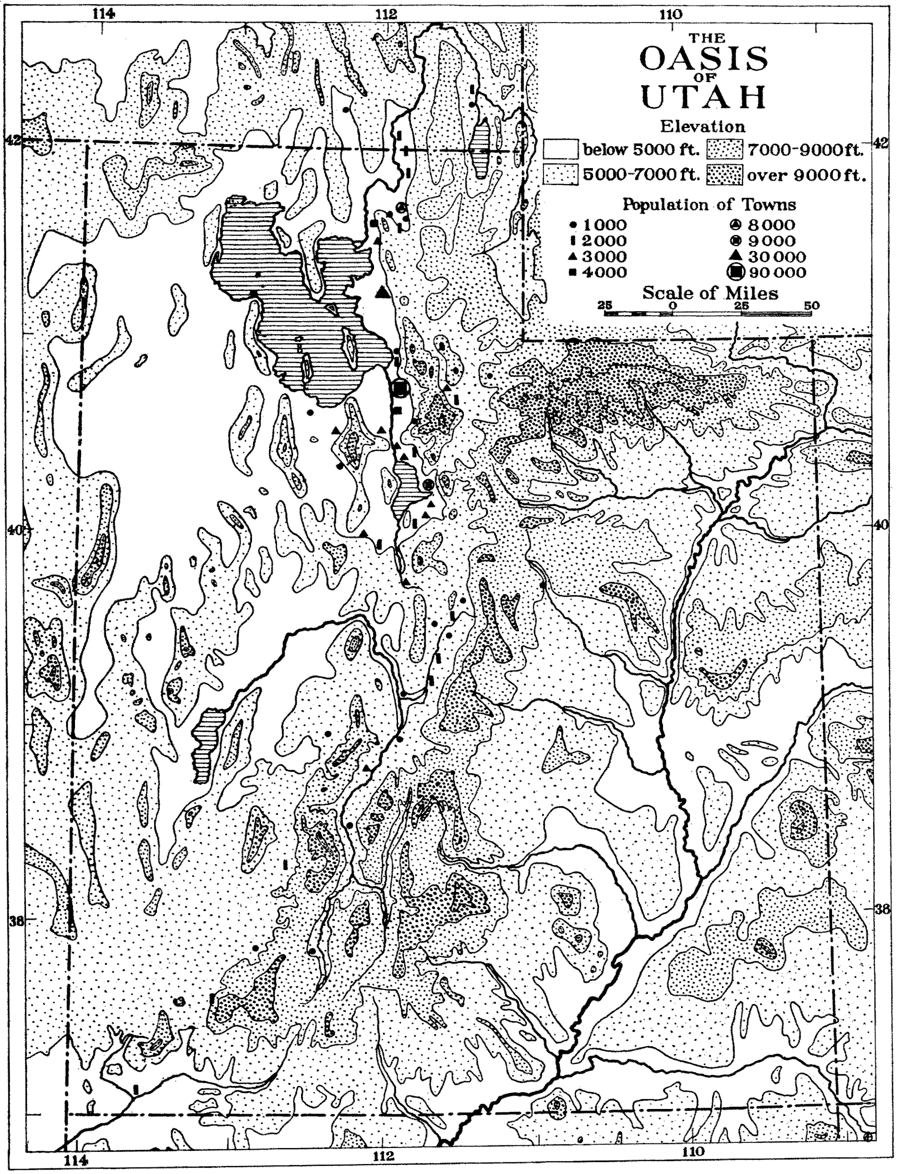

FIG. 1—The oasis of Utah: relief and cities. Scale, 1:4,300,000.

Relief is based on the contour map of the United States, 1:2,500,000, by the U. S. Geological Survey (1914); population of cities is based on the Thirteenth Census of 1910.

surface level of the desert. They are all that give Egypt its pretended width on the political map, for apart from them the only habitable land—"sown" land—is the long Nile flood-plain, very narrow, at most a nine-mile-wide strip of cultivable land.

They are none of them oases as the word is commonly used in English today. Characteristic is the depth of the oasis floor below the desert and the sharpness of the bounding cliffs, brought out excellently by the view of the Algerian oasis Laghouat from Robin's "La Terre" (Fig. 3). Siwa is 426 feet below the desert; Farafra, 626; Dakhel, 1,059; and Khargeh, 984. Bakharieh is an excellent example (Fig. 4). The desert above it has an elevation of 800-900 feet above the sea; the floor of the oasis itself, at Bawiti, of 367 feet, a difference of over 400-500 feet. The traveler approaches the oasis without suspecting it,—across a stony or sandy level. Of a sudden he finds himself at the brink of a precipice, under which nestles the village, with bordering palm groves and millet fields extending a little farther out on the floor of the depression. Each village is at a spring or well, and the spring is fed by the ground-water of the desert, emerging at the foot of the cliff. There is only water enough to irrigate a small part of the depression. The total area of Bakharieh is 300 square miles, but only six could be cultivated at the time of Rohlfs's expedition (1873-74). From these six square miles the 2,410 inhabitants of Bakharieh drew their sustenance. The name oasis, however, applies to the whole depression, though it contains a number of wells at considerable distances apart and a number of villages. Bakharieh has six inhabited places, Farafra two out of fifteen watered spots, and Khargeh eleven. From the floor of such an oasis the ragged, encircling cliffs look like a low mountain range. Several of them have the name *jebel* (mountain), and Rohlfs's map is marked "Rohlfs Gebirge" to the northeast of the Farafra oasis.[2]

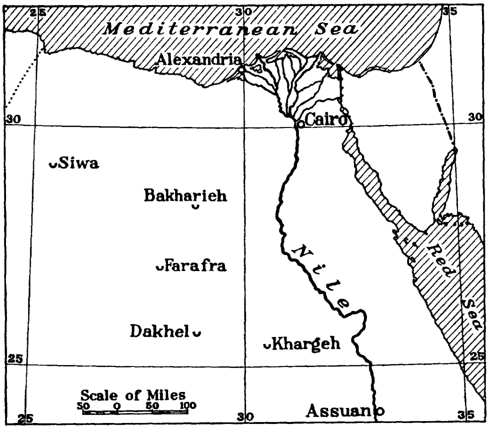

FIG. 2—Location of the five oases of the Libyan Desert, Siwa, Bakharieh, Farafra, Dakhel, and Khargeh, to which the Greek word *oasis* originally applied. Scale, 1:17,500,000.

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[2] The data about the oases are taken from the account of Rohlfs's journey of 1873-74 (Expedition zur Erforschung der Libyschen Wüste, 3 vols., Cassel, 1875-76, Vol. 3: Physische Geographie und Meteorologie, bearbeitet von W. Jordan), because it is still an excellent source of information. Reference should also be had to the reports on the topography and geology of the oases published by the Geological Survey of Egypt (Survey Dept., Cairo), as follows: Bakharieh [Baharia], by John Ball and H. J. L. Beadnell, 1903; Farafra, by H. J. L. Beadnell, 1901; Dakhel [Dakhla], by H. J. L. Beadnell, 1901; and Khargeh [Kharga], by John Ball, 1900. Geographers now have easy access to what little is known of Egyptian geography in the six-sheet Map of Egypt on the scale of 1: 1,000,000 published by the Survey Department at Cairo,

The Utah towns at the eastern border of the Bonneville Basin and the basin itself, 20,000 square miles in area, are here likened to one of these oases of the Libyan Desert, the Wasatch being the eastern portion of the bounding wall. The irrigable land of this oasis of Utah has a population density of 239 people to the square mile, where the Libyan oases have 530 to the square mile of cultivated land,—not too great a discrepancy when the differences in the standards of American and Arab life are considered.

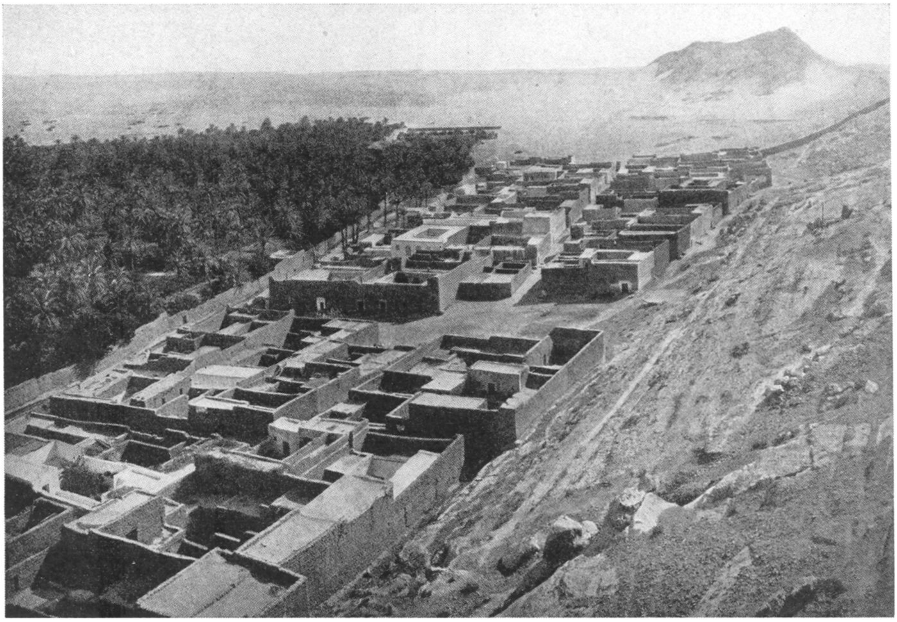

FIG. 3—The Algerian oasis of Laghouat. From Pl. VII, "La Terre: Ses aspects, sa structure, son évolution" by A. Robin, Larousse, Paris, 1902.

This view shows the cliffs, at whose foot lies the typical village with its cultivated area.

But the water of the Utah towns is not from wells and springs. It is stream water from the Wasatch, now well stored in reservoirs and economically applied to the soil. In general, rain comes of some sort of uplift to the air. Thus, mountains in the desert always have some rain from the uplift they give the winds. On the other hand descent warms air and favors evaporation rather than precipitation, and an interior basin has less rainfall because of the fact that air can only enter it by descent. The lowest

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1909. The oases are shown on Sheets 1, Alexandria, and 3, Western Oases, and it is at once perceived that Rohlfs made a highly important contribution to the knowledge of the region. The Selima oasis of Sheet 5, Libyan Desert, was not visited by Rohlfs and is very vaguely depicted. For one thing no elevations are given, but its impressionistic contours show the same depression as in the great oases. The Map of Egypt allows an instructive contrast between the Nubian Desert, east of the Nile, and the Libyan Desert to the west, for all the oases are in the west. The Nubian Desert consists of mountain ridges up to 6,000 feet, with its low places from 600 to 1,500, while the western depressions, as has been shown, run down below sea level. The Nubian Desert abounds in slopes strong enough to wash into a great number of dry stream channels, the desert *wadies*. In these the rare wells occur, but permanently inhabited oases are not shown there.

point in the United States is Death Valley, 220 feet below sea level, and it has less than five inches of annual precipitation. The whole Great Basin region is arid, for the prevailing winds get into it by descent across the Sierra Nevada or the Rockies. This is a matter of general knowledge. It is also certain that the Wasatch has much rain and the Uintas still more. The details are shown on the rainfall map by Henry Gannett (Fig. 5),[3] which gives the Great Basin 10 inches a year, the Wasatch upwards of 20 inches, and the Uintas as much as 40 inches. The local observer at Salt Lake City, A. H. Thiessen, draws a different map (Fig. 6).[4] Mr. Thiessen says "The rainfall of Utah has been accurately measured at many stations in the valleys, and at a few moderately high stations, but none at the highest levels, either in the Wasatch or the Uintas. It varies from 6 to 25 inches annually at points between 2,800 and 7,000 feet, and it is probable that as much as 30 inches or more falls at some places at the higher levels. This great variation is due almost wholly to topography. The stations on the western slopes of the mountains receive more moisture than those on the eastern slopes, and stations near the mountains more than do those on the same slopes but farther away from the base of the mountains; stations at higher levels receive more than those at lower levels, as a rule; but stations at the same level on different sides of a mountain will receive different amounts, the one on the western side usually the more." If gages between 5,000 and 7,000 feet yield 7 to 25 inches of rainfall it is probable that at points toward 12,000 feet more than 30 inches falls. Certainly the mountain rainfall is heavy.

In theory, at least, Utah lies in the belt of westerly winds, and these westerly winds should be adiabatically cooled as they ascend the western slopes and deposit their moisture there. Records of the Weather Bureau appear to show that Salt Lake City has a prevalent *southeast* wind. The invaluable Annual Report of the Chief of the Weather Bureau for 1896-1897, for instance, gives for the average of the five years 1891-1895 at Salt Lake City—

2241 hours of southeast wind,
1883 " " northwest "
936 " " south "
888 " " east "
785 " " west "
682 " " southwest "
634 " " north "
561 " " northeast "
3690 hours of N.E., E., and S.E. winds, against—
3350 hours of N.W., W., and S.W. winds.

Such other years as are available appear to show the same feature of easterly winds somewhat distinctly predominant over westerly. However,

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[3] From Pl. I, *U. S. Geol. Surv. Water-Supply Paper 301*. See also footnote 1 on p. 203 of the writer's article in the March *Review*.

[4] Leaflet entitled "Normal Annual Precipitation for Utah."

Salt Lake City's rainiest months, March, April, and May, had 785 hours of northwest wind to 460 of southeast. By the courtesy of the chief of the division of climatology of the Weather Bureau, Mr. P. C. Day, the writer is able to state that the wind at Salt Lake City seems to be in the northwest during most of the heavier rainfalls. Six of the "more important rainfalls" at that station were October 1 and November 18, 1910, April 5 and September 29, 1911, and May 30 and July 19, 1912. The respective rainfalls were 1.14, 0 70, 0.71, 0.85, 0.49, and 1.07 inches. While these rains were falling, the wind was in the northwest for 27 hours; in the north for 9; southwest,

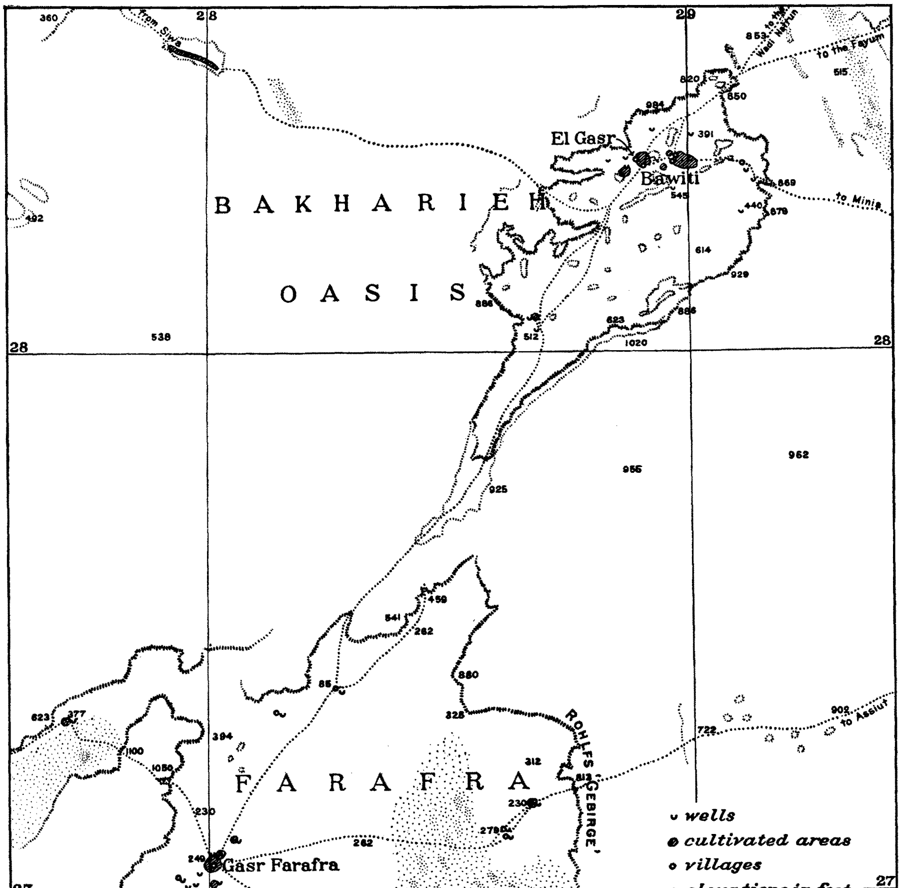

FIG. 4—The oases of Bakharieh and Farafra in the Libyan Desert. Scale, 1:1,540,000. Based on Sheets 1 and 3 of the Map of Egypt, 1:1,000,000, published by the Survey Department, Cairo, 1909 (for the original sources see footnote 2).

6; west, 4; south, 4; southeast, 4; and east and northeast for one hour each. To put it another way, the total rainfall on these six occasions was: with a northwest wind, 2.71 inches; with north, 0.70; with southeast, 0.38; with southwest, 0.24; with west, 0.20; with east, 0.20; and with northeast, 0.03. If the six cases selected are at all typical, the northwest is the rain wind. It is puzzling to see the east wind accompanied by the same rainfall as the west wind, though both are small. That the northwest brings the greatest rain may well be because the longest axis of Great Salt Lake stretches in a northwesterly direction from the city. The wind must have a very low humidity when it comes to the lake and must take up much vapor from its surface to drop it again on reaching the mountain slope in the immediate suburbs of the city. But as the lake in turn must draw its waters from the Wasatch streams, it will not do to ascribe more than a part of the rainfall on the range from the evaporation from the surface of the lake. We should expect other stations to have their precipitation with all-west winds. In general the local observers are not able to state what winds prevail when rain falls.

The drainage of the west slope of the Wasatch is mainly caught in streams flowing north and south along the west front or among the western ridges. These are the Bear River flowing northward from Bear Lake into Idaho and then south again into the east arm of Great Salt Lake (which it has turned to fresh water now that the railway has built its causeway across), the Jordan northward from Utah Lake to Great Salt Lake, and the Sevier, which flows north to a point near the middle of the state, where it turns south again to Sevier Lake. Most of the basin of northwestern Utah is quite without running water. It is a surprise to find the eastern portion of the state much better supplied with permanent streams, in view of the greater rainfall on the western slopes called for by theory, and reported by observer Thiessen. In the southeast, where the precipitation is as small as in the west, the Green and Colorado Rivers receive a number of considerable tributaries from the eastern slope of the Wasatch, and these streams appear to carry constant water supplies, although they come from the dry side of the range. Any map of the rivers of Utah shows strikingly this preponderance of running water on the eastern side of the range. Probably the rainfall is not at all sharply limited to the western slopes. It is not good theory to suppose that rain caused by uplift on a west-facing slope will leave the east slopes completely dry. It is to be expected that some rain will pass the crest and feed rivers on the leeward side also. This is observed in the Cascades, the Sierra Nevada, and the Andes of Patagonia. If settlement is limited to the western foot of the Wasatch, it is not wholly on account of superior water supplies, but especially because of the greater amount of level ground with deep soils. The deposits of ancient Lake Bonneville and the wash from the mountains in more recent days have tended to cloak the western foot of the range with a mantle of fine rock

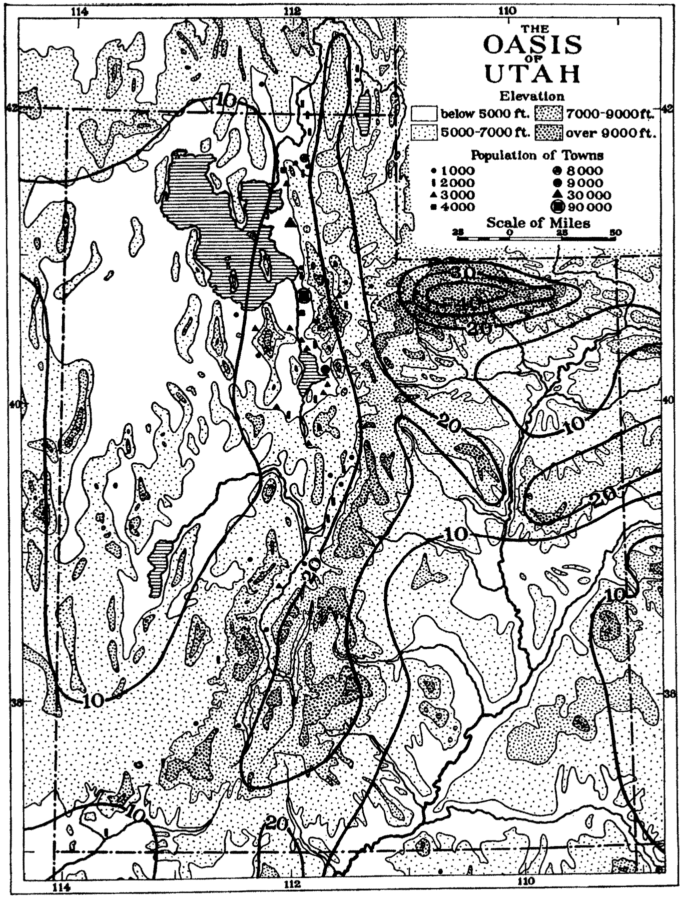

FIG. 5—Mean annual precipitation of Utah, according to Henry Gannett. Scale, 1:5,670,000. Based on Pl. I, *U. S. Geol. Surv. Water-Supply Paper 301*, 1912. Mr. Gannett took the mountain contours and vegetation into consideration in drawing his isohyetals (see the March *Review*, p. 203 ff).

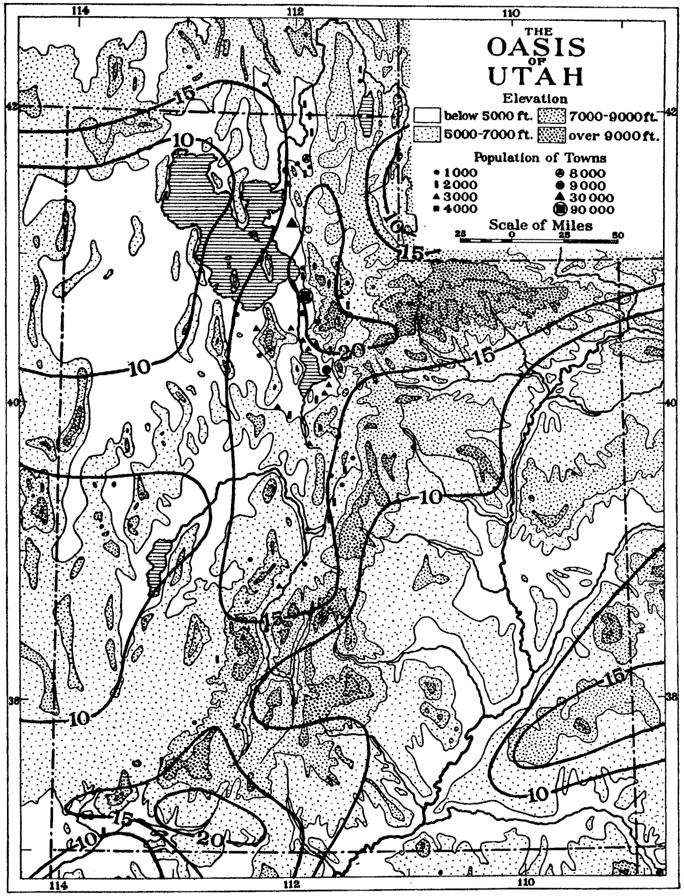

FIG. 6—Mean annual precipitation of Utah, according to A. H. Thiessen. Scale, 1:5,670,000. Based on a leaflet map entitled "Normal Annual Precipitation for Utah," about 1912.

Note on Fig. 6: This map is preferable to the rainfall maps of the U. S. Weather Bureau, because all data are included and none suppressed. It indicates rainfall in places as high as 20 inches where the Weather Bureau has but 15. Mr. Thiessen believes over 30 inches fall in the mountains.

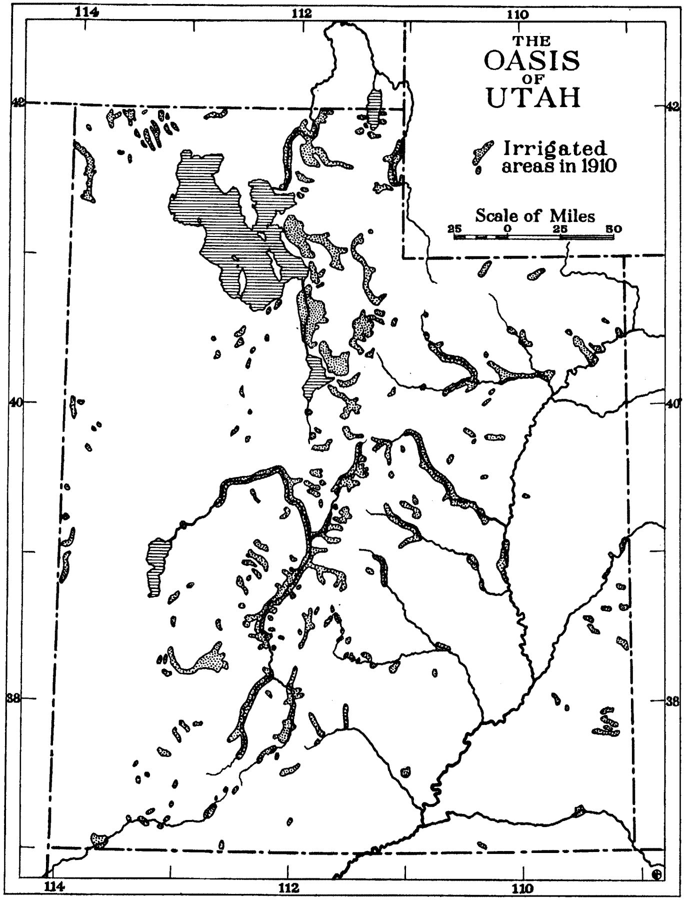

FIG. 7—The irrigated lands of Utah in 1910. Scale, 1:5,670,000. Based on Fig. 2, Pl. 404, Statistical Atlas of the United States, Bureau of the Census, 1914.

It is apparent that the irrigated lands lie mainly along the valleys at the west front of the Wasatch, like the cities in Fig. 1.

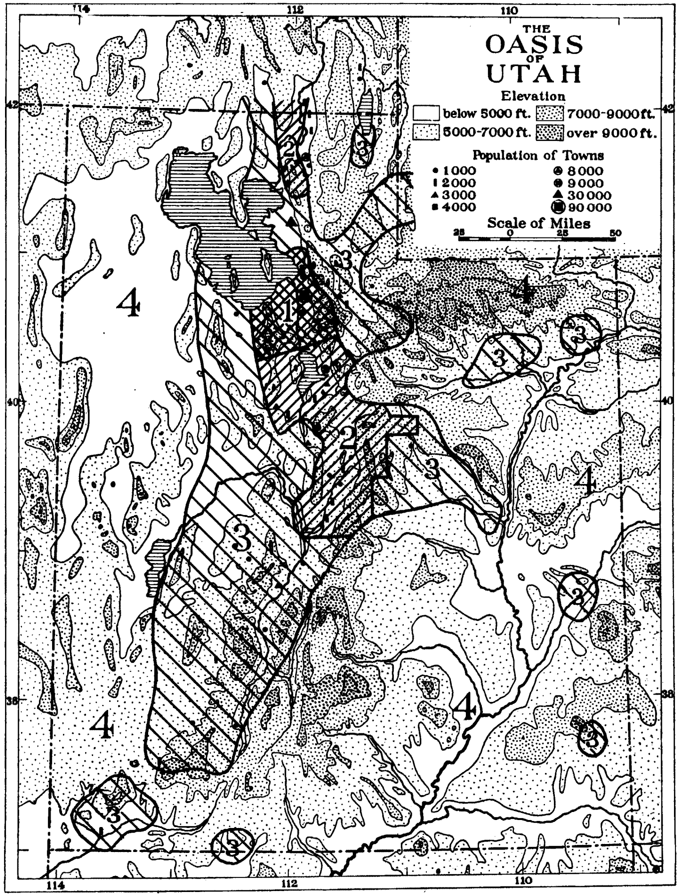

FIG. 8—Distribution of rural population in 1910. Scale, 1:5,670,000. Based on Pl. 15, Statistical Atlas of the United States, Bureau of the Census, 1914.

Note on Fig. 8: All the cities of 2,500 or more inhabitants have been subtracted from the population before computing the densities. Grade (4) has less than 2 people to the square mile; grade (3), from 2 to 6; grade (2), from 6 to 18; grade (1), from 18 to 45. The map shows the main distribution of people along the western front of the Wasatch, but includes some units of absolute desert in area (3).

waste which becomes a fertile soil as soon as water is added to it. The deep canyons of the Green and the Colorado cause the whole eastern region to be deeply dissected. Level expanses are very small there, and the finer waste has been carried off to the sea.

The representation of the settlements of a state by city symbols only, such as we have used here (Figs. 1, 5, 6, and 8), is novel and calls for brief comment. The best-known population maps for the United States are the very beautiful ones published by the Federal Census Bureau. The Utah portion of the map for 1910 is here roughly reproduced in Figure 8, which uses black shading and numbers for the brown shades of the original. The numeral 4 represents areas where the population per square mile is less than 2; 3, from 2 to 6; 2, from 6 to 18; and 1, from 18 to 45. Although the map is quite inadequate to represent the actual distribution of population, it does show that the population is mainly along the western foot of the mountains, with empty spaces westward and only very tiny scattered bits of settlement towards the east. It is inadequate because it represents only the "rural population, omitting all communities of over 2,500 people." The cities, if of 8,000 people, are represented by dots on the original map. They are Salt Lake City, Ogden, and Provo. There remain eleven cities between 2,500 and 8,000 population without representation on the map as the Census draws it, either by shading or dots for cities. These are Brigham, Logan, Park City, Murray, Tooele, Bingham, Lehi, American Fork, Springville, Spanish Fork, Nephi, and Richfield,—in all 34,086 people, nine per cent of the people of the state. Even if the whole population were used, the values obtained by dividing the population of a Utah county by its area are unsatisfactory, for the counties are so large and so often include much uninhabited wilderness that we may not think of their population as grouped evenly over their surface. The omission of these towns from the 1910 map is probably a mistake that arises from the fact that the Census has this decade revised its definition of rural communities as those with less than 2,500 people instead of 8,000, as was the former standard of discrimination. The 8,000 has still been retained, however, as the smallest size of cities to locate on the map with dots proportional to their size, but the population of all cities over 2,500 was subtracted from their counties before computing population density.

The separation of city from country that the Census makes is not justifiable. The rural and urban population are closely related, not merely in their origin but in all the activities of their daily life. The rural occupation of the land, the cutting of forests and putting fields under tillage has made little cities grow up all over the country and made the big ones yet bigger. The form that economic development has taken demands that much work which was formerly done on the farm be now done in cities. This is not merely in the manufacture of agricultural implements—though these are so important that they have made one man's labor on a farm go from sixteen to eighteen times as far as it did fifty years ago—, but in the preparation of food and clothing and sorting and classifying and storing for sale. If you double the rural population in any district it will quickly cause the urban centers near by to more than double, for the country needs the cities as much as the cities need the country. For example, Michigan and Wisconsin in 1870 had between them seven cities of more than 10,000 inhabitants. By 1910 the population of the two states had a little more than doubled, and there were 42 cities of that size! In the whole district of the Great Lakes in the same period, the cities had increased from 28 to 102. It is impossible today to conceive of the country apart from the city, so completely has it lost its one-time independence. They form an organic unit today, the country producing from the soil, but supplying itself with clothing, furnishings, much of its food, and a great variety of mechanisms from the city, which not merely eats the food the country supplies, but is busily engaged in sorting and distributing the products of both city and country to the consumers everywhere, as well as manufacturing them into other forms.

Instead of attempting to represent the actual distribution of people in the country by subtracting the city dwellers from the total population and representing the residue as the real occupants of the land, progress is to be made by constructing city maps in greater detail than have been usual yet and giving their symbols some connotation of size more legible and graphic than the customary methods allow. A map of cities is a map of foci of human activities. If it can be given a note of relative magnitude in the very symbols that locate the towns, such a map will express admirably the intensity with which men have occupied the ground. A little city must be little at a glance and a big one, big.

No use of type conveys the idea well enough, and the names themselves mask the expression of the map too much to be tolerated. If names must be added a key map should be made for the purpose. A little spot and a big one go some distance toward the expression desired, but only a few sizes can be thus discriminated. The solution is to aid the suggestion of size with that of *shape*. The device used here simply calls for counting corners, a little dot for a thousand, an elongated one for 2,000, a triangle for 3,000, a square for 4,000, an open circle for 5,000. The same symbols, enclosed in a circle, express the next four grades. Practice shows that the eye instantly distinguishes these values. A second size of symbols for cities ten times as large and running through the whole scale renders close size indication possible. The thought is throughout that the cities crown the agricultural occupation of the land and must multiply and must grow in size as more and more land is brought into occupation, or even as cultivation becomes more perfect and more intense. The spacing of the little cities is fixed by the extent to which country areas are improved, and the spacing of great ones is found to depend closely on the spacing of the smaller ones. It is for this reason that the map of Utah's irrigated lands accords so closely with that of her cities.

The scene that unfolded itself before Brigham Young's eyes that July morning in 1849, as he emerged from the pass in the Wasatch above the prairies green with the waters of the mountain creeks, had promise for him of homes for his faithful followers, but it contained also the germ of the unique group of cities and towns strung along the mountain foot today.